EFFECTS OF FRUCT-OLIGO-SACCHARIDES ORIGIN ON RABBIT'S GROWTH PERFORMANCE IN 2 SEASONS

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Abstract - The aim of this experiment was to study on growing rabbits the effects of 3 presentations of fructo-oligo-saccharides (FOS): fixed on organic support, in form of sirup or of freeze dried powder, introduced at 0.34% in a balanced diet. Growth rate, feed intake and feed conversion ratio (FCR) of a total of 300 weaned rabbits caged individually were measured during 6 weeks in spring or in summer. The average summer daily gain was reduced by 12% when compared to spring growth rate (33.2 *vs* 38.2 g.day), but the FCR was not affected. In the spring trial, the main effect of FOS inclusion was a 1.4% reduction of the FCR (3.26 *vs* 3.31 for the control diet). In summer the growth rate and FCR were improved but only during the last 3 weeks of the trial. For the whole summer period, the FCR reduction of 1.5% observed in the sirup group (3.25 vs 3.30 for control) was the only significant effect of FOS utilization. The effect of type of FOS presentation was inconsistant. when the 2 seasons are taken in account.

INTRODUCTION

In a previous experiment we have demonstrated a significantly lower feed conversion ratio in fattening rabbits fed a diet with 0.34% of fructo-oligo-saccharides (FOS) (LEBAS, 1993), and a similar observation was made by ROCA (1994). Otherwise, the promotor of the product mentioned better results when FOS are employed during the stressfull summer period, than during the more temperate seasons (BRUNEAU, 1991).

FOS are produced through an enzymatic treatment of sucrose (saccharose) producing a mixture of polyosides composed of one glucose + 2 to 4 fructose (mixtur of kestose, nystose and fructosyl-nystose). The process produced a sirup which is fixed on organic support and then dried and commercialized as Profeed®. The aim of the present experiments was to compare the relative efficiency of FOS employed in the classical form on organic support, or employed directly as sirup or after feeze drying of the sirup. In addition, the experiments were conducted in spring and in summer in order to measure the FOS interest during the summer heat stress.

MATERIAL AND METHODS

FOS sources and Diets

The three FOS sources employed were the commercial Profeed® (34% of FOS), a sirup containing 55% of FOS and a freeze-dried powder containing 85% of FOS. The name of the corresponding diets will be referenced as P34 , S55 and P85, in the present paper.

The diet's basic formula (control diet) was that employed in our previous experiment (LEBAS, 1993; Table 1). The FOS sources were substituted to alfalfa according to the following proportions (weight/weight) with the objective to obtain 0.34% of FOS in the diets.

P34 : 1% - **S55** : 0.62% - **L85** : 0.40%

The diets were prepared and pelleted one time for the spring test and a second time for the summer test.

Table 1 : Compostion of the control diet (% of ingredients)

Alfalfa dehydrated	28,12	Wheat straw	5,00
Wheat bran	20,00	Soya meal	8,00
Barley	5,00	Sunflower meal	8,00
Wheat	5,00	Beet pulp dehydrated	13,00
Oats	5,00	dl-méthionine	0,08
		Minerals & Vitamins	2,80

Animals and Experimental treatments

According to their individual weight, litter of origin and week of weaning (3 weeks fore each season), a total of 300 crossbred rabbits (male INRA9077 x female INRA1067) were allocated at weaning (28 days) to one of the 4 treatments corresponding to the *ad libitum* distribution of one of the 4 experimental diets. The rabbits were immediately placed in individual cages for the 6 weeks of observation. The distribution of rabbits among the 4 treatments and the 2 seasons, is indicated on Table 2.

Table 2 : Number of rabbits allocated to each treatment in each season.

Season	P34	S55	P85	Control
Spring	40	40	40	45
Summer	30	30	30	45

Individual weight and feed intake were measured every week. Results were pooled for the 3 first weeks of the experiments and for the 3 last weeks.

In the experimental building, the daily average temperature varied from 18°C to 22°C during the spring test (end of April to June 1993) and from 20°C to 29°C during the summer test (end of June to August 1993).

Statistical analysis

For each season, the treatments effects were analysed according to a variance analysis with help of the SAS-STAT package (SAS, 1988). The employed model included the effects of treatment (n=4), week of weaning (n=3), the interaction and the initial weight as covariate. The analysis of the combined 2 seasons included in addition the season effect and the season x treatment interaction. The average effects of treatment or FOS addition (P34 + S55 + L85 *vs* Control) were compared with the contrast method (SAS, 1988).

RESULTS

Feeds composition

The analytical composition of the experimental diets is indicated on Table 3. The gross composition was in good accordance with the calculation. The FOS contents were more variable. For the spring diets, the analytical values were lower than the calculated 0.34% (0.24 to 0.29%). The dispersion of the values was greater in the summer diets (0.26 to 0.52%). Nevertheles it must be emphasised that the average of the 6 diets was 0.31% which is close to the calculated 0.34%

Mortality

During the spring trial, two rabbits died from diarrhea in the P85 group. During the summer trial, one rabbit died in the control group. The very low mortality (1%) can be considered as negligible and in any case not related to the FOS content or origin.

Table 3 : Analytical composition of the experimental diets

Nutrients (% as fed)	DIETS R34	S55	P85	Control
Spring				
- Dry matter	89,2	88,6	89,6	88,8
- Crude protein	16,2	16,5	16,2	16,6
- Ash	7,7	7,8	8,3	7,6
- Crude fiber	17,3	17,5	16,9	17,4
- Gross Energy (kcal)	3816	3805	3836	3841
- FOS	0,24	0,29	0,23	0,00
Summer				
- Dry matter	90,8	90,8	90,2	90,8
- Crude protein	16,7	16,8	16,9	17,0
- Ash	8,5	8,0	8,2	8,5
- Crude fiber	16,9	17,6	15,8	16,8
- Gross Energy(kcal)	3903	4008	3868	3912
- FOS	0,52	0,26	0,32	0,00

Spring trial

The growth rate, feed intake and feed convertion ratio (FCR) are summarized in the Table 4.

Table 4 : Peformance of rabbits during the spring trial (least square means)

Criteria	DIETS R34	S55	P85	Control	*Residual Coef Var %*	Statistics
- Initial weight (g)	521	526	526	527	*3.72*	
- Final weight (g)	2121	2121	2151	2103	*5.89*	P 85>C
First 3 weeks						
- Average daily gain (g/day)	45,2	45,1	45,1	44,7	*8.35*	
- Feed intake (g/day)	105,2	102,9	101,6	102,7	*6.94*	
- Feed conversion ratio	2,33	2,29	2,27	2,30	*7.39*	
Last 3 weeks						
- Average daily gain (g/day)	31,0	30,9	32,2	30,4	*13.77*	P85>C
- Feed .intake (g/day)	146,5	144,6	146,2	145,5	*7.72*	
- Feed conversion ratio	4,77	4,75	4,59	4,84	*9.34*	P85 <C & FOS<C
Whole experimental period						
Average daily gain (g/day)	38,1	38,0	38,7	37,5	*7.69*	P85>C
- Feed intake (g/day)	125,9	123,7	123,9	124,2	*6.41*	
- Feed conversion ratio	3,31	3,27	3,21	3,31	*4.85*	P85<C & FOS<C

Note : only significant effects (P<0.05) are mentioned for each experimental diet *vs* Control and for FOS *vs* Control (C)

During the first 3 weeks of the experiment, no significant differences were observed between the experimental groups. During the last 3 weeks, P85 rabbits had a higher growth rate than the control (32.3 *vs* 30.4 g.day) and the FRC was also also mofidied (4.59 *vs* 4.84 for the control group). During this last period, the average FCR observed for the 3 diets with FOS (4.70) was also significantly lower (-3%) than that observed for the control. For the whole experimental period, the average effects were those observed during the end of the period.

Summer trial

The growth rate, feed intake and feed convertion ratio are summarized in the Table 5.

Table 5: Peformance of rabbits during the summer trial (least square means)

Criteria	DIETS R34	S55	P85	Control	*Residual Coef of Variation %*	Statistics
- Initial weight (g)	573	576	573	572	*4.80*	
- Final weight (g)	1965	1985	1975	1981	*6.01*	
First 3 weeks						
- Average daily gain (g/day)	41,9	41,5	42,2	43,0	*9.24*	FOS<C
- Feed intake (g/day)	99,1	97,6	100,6	99,4	*8.35*	
- Feed conversion ratio	2,37	2,36	2,39	2,32	*8.78*	
Last 3 weeks						
- Average daily gain (g/day)	24,4	25,6	24,6	24,1	*18.70*	S55>C
- Feed .intake (g/day)	118,6	119,4	121,5	119,2	*8.93*	.
- Feed conversion ratio	5.05	4,70	5,18	5.15	*27.13*	S55<C
Whole experimental period						
Average daily gain (g/day)	33,1	33,6	33,4	33,5	*8.48*	
- Feed intake (g/day)	108,9	108,5	111,0	109,3	*6.75*	
- Feed conversion ratio	3,29	3,23	3,34	3,28	*6.34*	

Note : only significant effects (P<0.05) are mentioned for each experimental diet *vs* Control and for FOS *vs* Control (C)

During the first 3 experimental weeks, the higher growth rate was observed for the Control group. During the last 3 experimental weeks, rabbits of the S55 group obtained the best performance : higher growth rate and lower FCR. (-8.7%). For the whole experimental period none of the differences observed were significant.

Average performance during the 2 seasons

Season effect - During the first 3 weeks of the summer trial, rabbit's growth rate was reduced by 6.4% relatively to the spring performance (P<0.01). During the last 3 weeks, the reduction was greater : -21% (P<0.01). On average, the daily growth rate was reduced by 12% in summer: 33.2 *vs* 38.2 g/day. This was the consequence of lower feed intakes since none of the differences between FCR were significant.

FOS effect - The average effects of FOS introduction in the diets are summarized in Table 6. It can be emphasised that no significant effects were observed during the first 3 weeks. During the 3 following weeks, the FOS introduction in diets induced a better growth rate and an average FCR reduction of 4.5%. Nevertheless this effect was not great enough to induce a significant effect when the whole experimental period was taken in consideration. Only the S55 source of FOS was able to improve the FCR for the whole experimental period (-1.5%)

Table 6: Average performance of rabbits for the 2 seasons (least square means)

Criteria	DIETS R34	S55	P85	Control	*Resid Coef of Variation %*	Probability of different Effects (1) FOS	R/C	S/C	P/C
- Initial weight (g)	544	548	546	551	*4.23*				
- Final weight (g)	2043	2048	2061	2036	*5.73*				
First 3 weeks									
- Average daily gain (g/day)	43,6	43,3	43,6	43,9	*8.67*				
- Feed intake (g/day)	102,2	99,9	100,9	101,1	*7.44*				
- Feed conversion ratio	2,35	2,32	2,33	2,31	*8.02*				
Last 3 weeks									
- Average daily gain (g/day)	27,7	28,21	28,44	27,01	*15.05*	**	ns	*	**
- Feed .intake (g/day)	132,5	131,8	133,7	132,2	*8.18*				
- Feed conversion ratio	4,91	4,71	4,88	5,06	*17.45*	*	ns	**	ns
Whole experimental period									
- Average daily gain (g/day)	**35,6**	**35,7**	**36,0**	**35,5**	***7.81***				
- Feed intake (g/day)	**117,4**	**115,9**	**117,3**	**116,7**	***6.45***				
- Feed conversion ratio	**3,30**	**3,25**	**3,27**	**3,30**	***5.58***	**ns**	**ns**	*	**ns**

(1) For the statistical comparisons, when the effect of treatments was significant, the general effects of FOS addition and the effects of each source of FOS compared to control diet, are indicated as follows: * P<0.10 and ** P<0.05 and ns = non significant.

Only one interaction between season and type of diet was significant ($P<0.05$). It concerned the FCR for the whole experimental period, and was caused by the diet P85: it's FRC was the best in the spring trial and the worst in the summer one.

DISCUSSION AND CONCLUSION

The FOS content measured in the different experimental diets was not exactly that calculated. But as the average FOS level was close to the calculated one, the variations were most probably a consequence of samples quality (in the experimental unit and/or in the laboratory). Nevertheless if the values measured were true, this should have no great consequence on the rabbit's performance since ROCA (1994) has observed a significant response after an addition of 0.24% of FOS, instead of the theoretical 0.34% in our experiment.

The main effect of FOS introduction was a reduction of the feed conversion ratio without any significant variation of the growth rate. The same situation was observed in our previous experiment (LEBAS, 1993) and in the experiment mentioned by ROCA (1994). Only MENDEZ *et al.* (1993) observed simultaneously an improvement of growth and a reduction of FCR.

The effect of the FOS source vary significantly from one trial to the other. Then it cannot be conclude on the best or the worst source for practical purpose. During the summer trial, an effective thermic stress was observed since the feed intake and growth rate were widely reduced. These conditions were adapted to test a potential greater effet of FOS utilization under thermic stress conditions (BRUNEAU, 1991). Unfortunately, the FOS utilization reduced significantly the FCR by 1.4% in the spring trial (and by 3% during the last 3 weeks) but no significant average effect of FOS was observed in the summer trial, even if FCR was reduced by 4.5% at the end of the summer experiment. Then the initial hypothesis should be forsaken.

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Effet de l'origine des fructo-oligo-saccharides sur les performances de croissance de lapins au cours de 2 saisons - L'auteur a comparé au printemps puis en été les performances de croissance de lapereaux de 28 jours recevant pendant 6 semaines soit un aliment témoin soit un aliment contenant 0.34% du fructo-oligo-saccharides (FOS) présentés sur un support organique, sous forme de sirop ou de poudre lyophilisée. En été, la vitesse de croissance des lapins est réduite de 12% par rapport à celle enregistrée au printemps (33.2 *vs* 38.2 g/jour). Par contre, l'indice de consommation (IC) n'est pas affecté par la saison. Au printemps, l'effet principal de l'inclusion de FOS est une réduction de 1,4% de l'IC (3.26 vs 3.31 pour le témoin). En été, l'inclusion de FOS dans l'aliment permet de réduire l'IC et d'améliorer la vitesse de croissance, mais cet effet n'est observé que pour les 3 dernières semaines de l'essai et n'est plus significatif pour la période globale d'engraissement. Pour cette dernière, le seul effet significatif est la réduction de 1,5% de l'IC observé dans le lot ayant reçu les FOS sous forme de sirop (3.25 *vs* 3.30 pour le témoin). Si l'on prend en considération les 2 saisons, il ne peut être conclu sur l'intérêt d'une présentation particulière des FOS.
